# 3R TQC & 3R mTQC

## Manual

3R Technics GmbH
Technoparkstrasse 1
CH - 8005 Zürich

Phone: 0041 – 44 – 445 13 13
E-mail: info@3r-technics.com

# Operating manual
# 3R TQC & 3R mTQC

Software version V.5.3.1

May 14, 2009

# Product overview

The product range is divided into two main groups; The first group consists of **3R TQC** software products dedicated to non-destructive measurement of mechanical material qualities, for their quantitative verification with high accuracy. The second group consists of **3R AMI** software products dedicated to material identification. All the software is available also as complex solution including hardware. Integration of customers' specific requirements is certainty. T-versions are independent from hardware and therefore applicable for processing of optional data from various areas.

3R TQC

3R TQC Standard – the software comprises a complex mathematical model and therefore high accuracy and stability is secured. It is possible to measure 6 or even more target values at the same time. The measurement hardware is automatically controlled.

3R TQC Standard T – the software comprises a complex mathematical model and therefore high accuracy and stability is secured. It is possible to measure 6 or even more target values at the same time. This software is independent from hardware due to loading data from a text file, and therefore usable for optional target values computation.

3R TQC Basic – the software comprises a simplified mathematical model. Less number of calibration samples is its advantage. It is designed for measurement of one target value. The measurement hardware is operated automatically.

3R TQC Basic 2Z – the software comprises a simplified mathematical model. Less number of calibration samples is its advantage. It is designed for measurement of two target values. The measurement hardware is operated automatically.

3R TQC Basic 6Z – the software comprises a simplified mathematical model. Less number of calibration samples is its advantage. It is designed for measurement of six target values. The measurement hardware is operated automatically.

3R TQC Basic T – the software comprises a simplified mathematical model. Less number of calibration samples is its advantage. It is designed for measurement of one target value. This software is independent from hardware due to loading data from a text file, and therefore usable for optional target values computation.

3R TQC Basic 2Z-T – the software comprises a simplified mathematical model. Less number of calibration samples is its advantage. It is designed for measurement of two target values. This software is independent from hardware due to loading data from a text file, and therefore usable for optional target values computation.

3R TQC Basic 6Z-T – the software comprises a simplified mathematical model. Less number of calibration samples is its advantage. It is designed for measurement of six target values. This software is independent from hardware due to loading data from a text file, and therefore usable for optional target values computation.

3R AMI

3R AMI – the software comprises a high effective mathematical model capable to identify and sort reliably also very similar materials. The measurement hardware is operated automatically.

3R AMI T – the software comprises a high effective mathematical model capable to identify and sort reliably also very similar materials. This software is independent from hardware due to loading data from a text file, and therefore usable for optional target values computation.

## Special

3R mTQC a 3R mAMI are superior programs allowing parallel control and evaluation of more measurements.

# Table of contents

# Introduction

With the 3R TQC software (3R TOTAL QUALITY CONTROL) it is possible to identify materials such as Rp0.2, Rm, Ag, HV etc. nondestructively.

This manual is applicable to all the variations of 3R TQC software (basic, standard, etc.)

This manual describes the installation and the operation of the 3R TQC software witch can be dedicated to the computation of mechanical material parameters based on the eddy current measured values. Eddy current data are measured with the help of the eddy current device Magnatest D SGP (software No. 1.8 or higher) created by Institut Dr. Foerster. The settings of the eddy current device are adjusted at the device as usual. The 3R TQC software performs the selection of the test definition, the coil adjustment, the initiation of the measurement and the computation of the mechanical material parameters. The 3R TQC software can be installed on a Windows XP computer and communicates with the Magnatest D eddy current device and/or their software by the TCP/IP interface or directly by the Magnatest D eddy current device and via local host. Before the quantitative measurement of the mechanical material parameters is possible, a calibration process has to be done for each material what means for each material sort or material designation and each dimension, for example with sheet metals for each thickness, with round material for each diameter and with the pipes also for each wall-thickness. With more complex geometry the calibration must be done for each partial geometry and/or for each measuring point.

## 3R mTQC

3R mAMI software enables multitasking with more 3R AMI systems. Thus it enables measurement with several coils or several measuring devices at the same time, central control, configuration and administration of individual measuring devices. This software enables measurement on several lines or several machines at the same time and coordination of these measurements from the same place. The operation of 3R mTQC software is the same like the operation of 3R TQC software only with a few differences. The differences in operation are described in following chapters: “Division of commands and actions”, “TCP/IP-connection – during the first start of 3R mTQC”, “Change of the TCP/IP configuration – 3R mTQC”, “TCP/IP Connection” and “Deliverance of the measured data”. The operation not described in these chapters corresponds with the operation of 3R TQC software with one exception - namely remote operation. When operating 3R mTQC software, the commands are sent to the 3R TQC software which acts as if being operated directly.

During the operation the distinction between actions that can be carried out simultaneously on several measuring devices and those that have to be done

separately must be made. The settings in the main menu must be carried out accordingly (see Figure 1). If the circlet on the upper right side is activated (a green dot inside), the commands will be sent to all measuring devices. In case it is not activated, the measuring device to which the orders should be sent must be selected from the pull-down menu in the upper right corner.

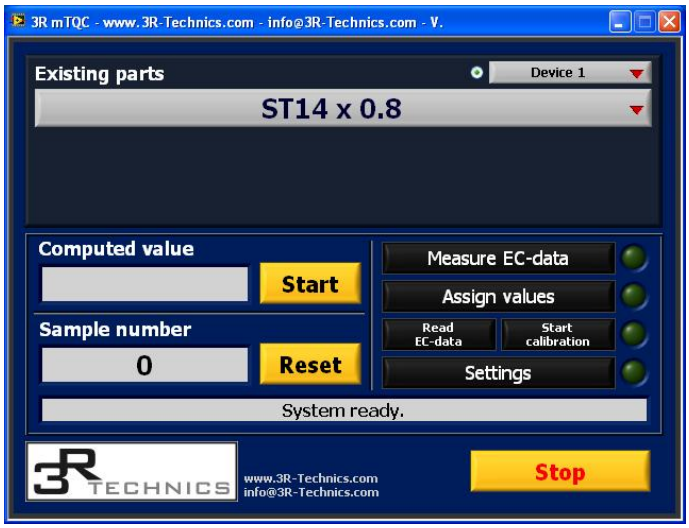



Figure 1: main window for 3R mTQC

## Division of commands and actions

Simultaneously

Measure EC-data

Step 5 – Inspection - application of the 3R TQC software - computation of the mechanical material characteristic

Separately

Assign values

Read EC-data

Start calibration

Settings

Commands and actions will be explained further.

The communication between 3R TQC and 3R mTQC is possible only after being set properly. The settings description can be found in the chapters “TCP/IP-connection – during the first start of the 3R mTQC” and “TCP/IP Connection”. 3R mTQC software is an extension of 3R TQC and cannot be used separately.

## Process of the calibration:

1. Acquisition of the eddy-current data
2. Accomplishment of the conventional testing of materials, e.g. tensile test, hardness measurement etc. The kind of the measurement depends on the goal size, therefore e.g. for Rp0.2 a tensile test must be done.
3. Entering of the conventionally determined material parameters into the 3R TQC software
4. Calibration of the 3R TQC software
5. Application of the 3R TQC software - computation of the mechanical material characteristic

Areas in the text highlighted by <<XYZ>> denote buttons in the program that can be seen in the associated figure.

*Italic and underlined* text denotes pure display elements that can be seen in the associated figure, or data identifiers.

# Installation

The installation window is opened by double clicking *setup.exe* (see Figure 2).

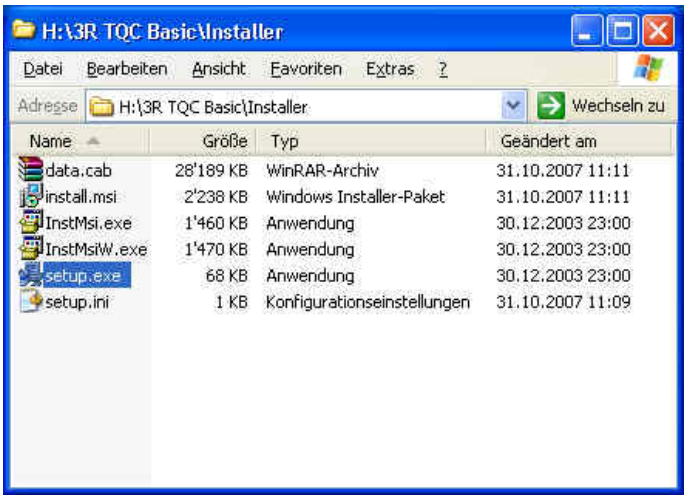



Figure 2: installation files

After starting the installation window, the instructions of the installation wizard follow.

# First steps

On the program start a menu window with the possibility to change the language will appear. This window will show up only for the first time the program is started, but in the menu <<Settings>> the language can be changed also later.


Figure 3: language change

In the following window the registration of the software can be started. Without the registration the program can be used for 30 days.


Figure 4: registration possibility

After the registration this window will not appear any more and the software can be used on one computer for an unlimited period of time.

# TCP/IP-connection – during the first start of the 3R TQC

In the next menu window the TCP/IP-connection settings for 3R TQC can be configured. This window appears after pressing the <<next>> button or after the registration.


Figure 5: Configuration of the IP-Address

In order to ensure the communication between the PC on which the 3R TQC software was installed and the eddy-current device, the correct IP address of the eddy-current device must be entered (see Figure 5). If the 3R TQC software was installed directly on the MAGNATEST D SGP device, the localhost address must be entered or the <<Localhost>> button must be pressed (see Figure 6). This

window shows up at the first start of the software or after loading the access code (see below). The IP address can be changed later in the menu <<Settings>> <<Change IP-address>>.

The computer and the eddy-current device must be connected through a network cable and a switch (small local network, see Figure 7) or through a company network.


Figure 6: configuration of the localhost address

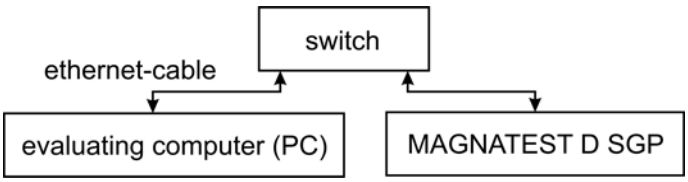



Figure 7: small local network

# TCP/IP-connection – during the first start of the 3R mTQC

In the next menu window the TCP/IP-connection settings for 3R mTQC can be configured (see Figure 8). This window appears after pressing the <<next>> button or after the registration.

The name of the measuring device is entered into the table with the white background. If you e.g. have 3 measuring devices you want to measure simultaneously with the help of 3R mTQC, it is possible to assign each of them a name, e.g. Device 1, Device 2, etc. At the same time the IP-address and the port number must be entered. It is also necessary to define the disc or disc partition where the 3R Technics directory is stored. The 3R Technics directory is always located on the same disc or disc partition along with Windows® operating system. This disc or disc partition must be accessible for 3R mTQC software

since 3R TQC software and 3R mTQC software share the data and directories of the 3R TQC software that are on the measuring device. Name, IP-Address, Port and disc must be entered and confirmed by pressing the <<Add>> button for each measuring device individually. After the confirmation the setting will appear in the table with the grey background. The measuring device settings can be deleted by selecting the device's name in the pull-down menu and pressing the <<Delete>> button (see Figure 9). All changes must be confirmed by pressing the <<Accept>> button. Work in this window is done by pressing the <<Finished>> button.


Figure 8: configuration of the TCP/IP-connection

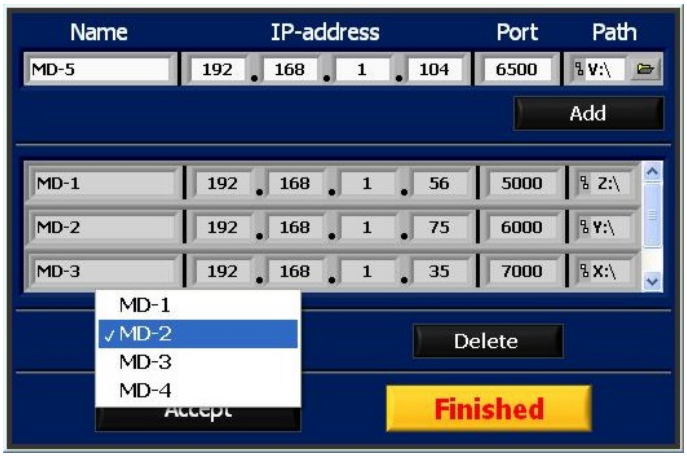



Figure 9: configuration of the TCP/IP-connection – delete the measuring device

# Access code

At the first start of the program the registration window will appear via which a computer-dependent license <<Save license number>> (as a 3RT file) can be stored in a user-defined place on the computer. After sending it by email to 3R Technics - info@3r-technics.com (see Figure 10) the access code will be immediately generated and returned.

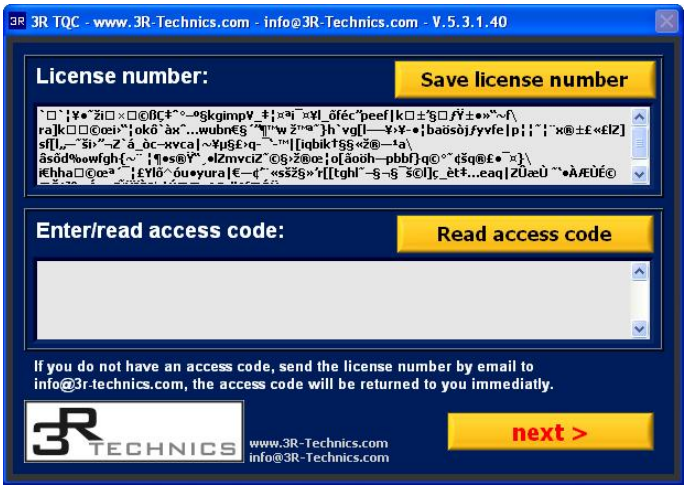



Figure 10: the license number saving

If the button <<next>> is pressed without loading the access code, the program can be used for 30 days. After 30 days the program will not work any more. The warning shown in Figure 4, from which the registration window can be accessed, will show up at every program start. As soon as the access code in the file "*Accesscode.3RT*" is returned and stored at a user-defined place, the software can be started. By clicking the <<Register>> button in the warning message (Figure 10), the registration window opens again. Press the <<Read the access code>> button, select the file Accesscode.3RT and open it. The access code is loaded (see Figure 11) and after pressing <<next>> the software is activated.

The window for unlocking of the program (Figure 10 and Figure 11) will not show up any more after registration and it is possible to use the software on this computer for an unlimited period of time. The purchase of a new license is necessary for using the software on another computer. After pressing the << next>> button the main window of the program (Figure 12) opens up.

If the communication between the PC or the 3R TQC software and the MAGNATEST D SGP equipment and its software works correctly the message "*System ready*" will appear in the status line (see above "TCP-IP-connection").

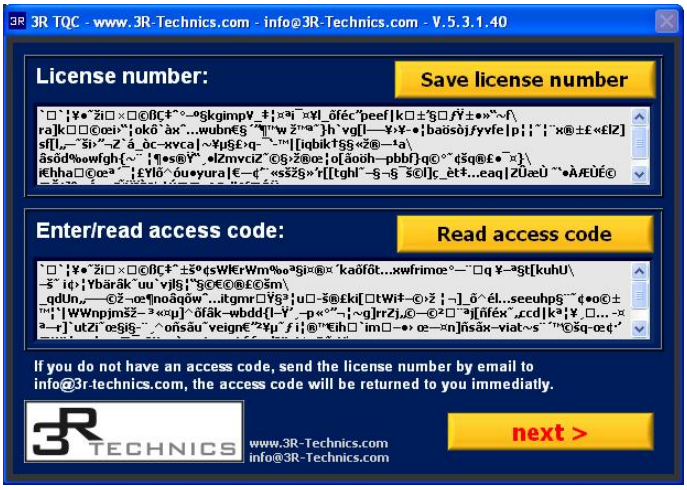



Figure 11: the access code loading


Figure 12: main window

# Calibration

## Process of calibration

1. Acquisition of the eddy-current values
2. Accomplishment of the conventional testing of materials e.g. tensile test, hardness measurement etc.. The kind of the measurement depends on the goal size, then e.g. for Rp0.2 a tensile test must be accomplished.
3. Entering of the conventionally determined material parameters into the 3R TQC software
4. Calibration of the 3R TQC software
5. Inspection – application of the 3R TQC software – computation of the mechanical material characteristic

## Step 1 – Acquisition of the eddy-current values

Before the 3R TQC software usage on quantitative measuring of the mechanical material parameters calibration must be done. The calibration must be done for each material, material sort or material designation or each dimension, for example by sheet metal for each thickness, by round material for each diameter and by pipes also for each wall thickness. By more complex geometries the calibration must be done for each part of the geometry or for each measuring point.


Figure 13: input of the product name

For each material/part a name can be assigned freely, e.g. “HC260LA_20x1” as shown in Figure 13. Before the name can be entered, the button <<Measure EC-data>> and afterwards the button on the right side of the *New part* input field must be pressed (Figure 14 and Figure 13). This activates the input field and enables to enter the name for a new product. No special characters can be used by the input of the name. The products to which a name was already assigned can be selected from the pull-down menu *Existing parts* (Figure 15).

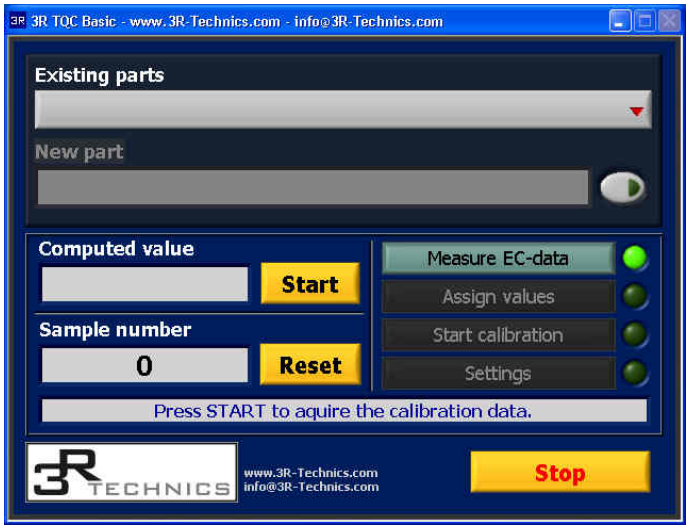



Figure 14: before the first input - input field inactive


Figure 15: select an existing product

The acquisition of the eddy-current values is activated by pressing the <<Start>> button, at the same time the name is stored. It means, among other things, that it may be chosen from the pull-down menu. Afterwards, the button on the right side of the input field *New part* can be pressed to deactivate the input field. It does not matter when it is not done after the first measurement of a material. During the acquisition of the eddy-current data the input field can either be active or inactive.

To make the operation easier the current test definitions stored on the MAGNATEST D are loaded (see Figure 16, Figure 17 and Figure 18) and offered as options for the user. Loading of the test definitions can take a few seconds or a minute or two; it depends on the number of test definitions stored on the eddy-current device. By the selection of the test definition the maximum number of parameter sets, which is 24, has to be respected. The MAGNATEST D SGP works automatically in laboratory mode. The number written after ">" shows the number of parameter sets. After a test definition was selected, the <<Finished>> button should be pressed to proceed. Immediately the coil adjustment is automatically started (see Figure 19) and it takes a few seconds. Please, follow the instructions on the screen. The button <<Read test definition>> should be pressed only if a new test definition which does not appear in the list was generated during the selection. Test definitions already assigned to a product in the 3R TQC software are displayed grey and cannot be selected. If this product is deleted (see menu <<Settings>>), this test definition will be used again. If coil adjustment was not carried out correctly (the sample was not in the coil etc.) it may be done again by pressing <<Coil adaptation>>. Immediately after coil adjustment is finished, measuring on this sample is carried out (see Figure 20 and Figure 21).

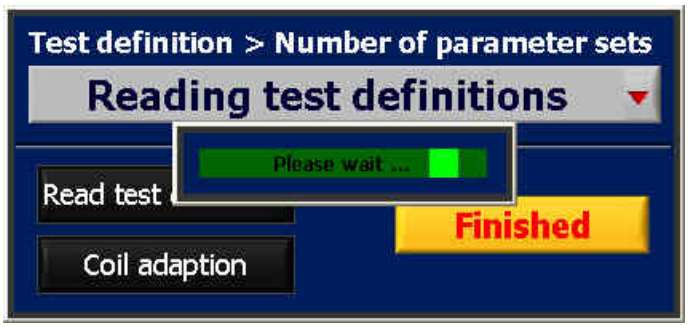



Figure 16: test definitions are loaded


Figure 17: the test definitions were loaded

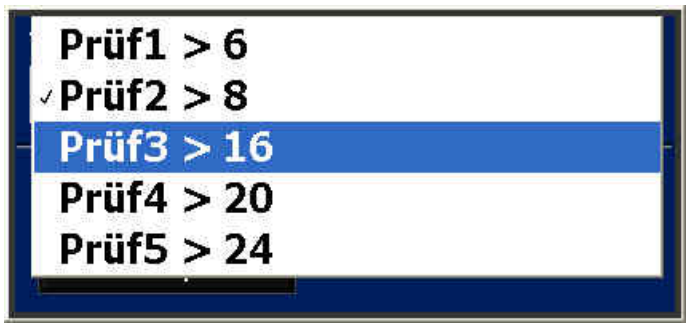



Figure 18: selection of the test definition


Figure 19: the coil adjustment is started

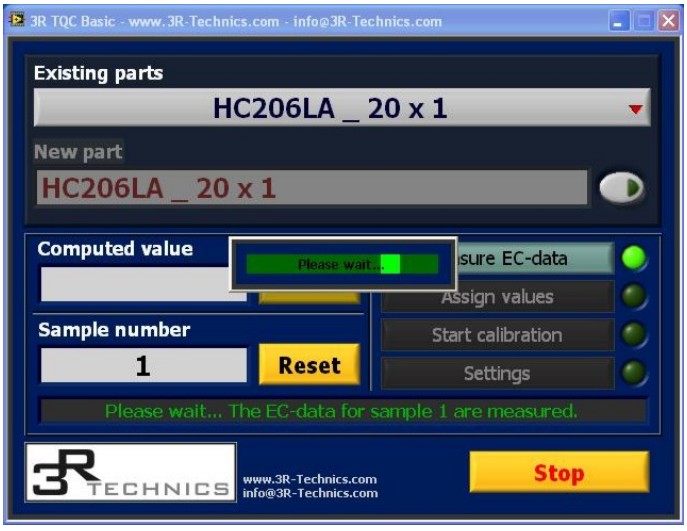



Figure 20: the first sample for HC260LA_20x1 is measured with the eddy-current system


Figure 21: the first sample for HC260LA_20x1 was measured with the eddy-current system

## Important

It is very important to mark the samples measured with the eddy-current system with the numbers *Sample number* given by the 3R TQC software. This number guaranties the correct assignment of the eddy-current data to the material. A wrong assignment can cause a wrong, sometimes even a useless calibration and must be done again. The numeration always begins with 1. The <<Reset>> button does not work during the calibration, only during the following testing;

otherwise the unique allocation of the eddy-current values to the material description (steel grade, thermal treatment etc.) cannot be assured.

The 3R TQC software works with up to 24 frequencies including the harmonious evaluation.

### Boundary conditions

For the calibration of the basic version at least 6 samples with as different qualities as possible are necessary, but it is recommended to use 10 or more samples. To calibrate software with higher versions of models at least 6 charges with as different qualities as possible, and of each charge at least 5 samples, are required. It is recommended to use 10 or more charges with different qualities. It is not possible to accomplish a correct calibration if the calibration samples have the same or very similar qualities, because good measurement results can be reached then only in a very narrow range. At least the quality for which the software should be calibrated must vary. The larger the dispersion within the permissible borders for the quality which is to be examined after the calibration is, the more stable, more reliable and more exact measured values are supplied. Artificially and/or intentionally produced dispersions did not work satisfactorily. The qualities of the calibration samples should reflect the "normal" dispersion in production.

The admission of the eddy current measured values for a calibration does not have to be accomplished at once. If e.g. the material is processed by different suppliers, it is useful for the calibration to take a few samples of the material by each supplier. It would be even better if several supplies (loads) from each supplier would be available, out of which samples could be taken.

## Step 2 – accomplishment of the conventional testing of materials

The accomplishment of the conventional testing of materials, like the tensile test or hardness measurement, is not described in this manual. Instructions of the particular equipment suppliers must be obeyed.

### Important

Because the 3R TQC software is calibrated by the measured values which are determined by tensile test or hardness measurement and/or further conventional testing methods, the preciseness of these measured values is reflected directly in the preciseness of the 3R TQC software. Therefore a great attention should be paid to the determination of the measured values.

# Step 3 – Assignment of the conventionally determined material values

To be able to enter the conventionally determined material data and to assign the eddy current measured values, the button <<Assign values>> must be pressed, the suitable product name, e.g. tubing dimension, from the pull-down menu selected, and <<Start>> button pressed (see Figure 22). Subsequently, the assigning menu appears (see Figure 25).

In a software version designed for several target values, a <<Choose target value>> menu appears before, in which one target value must be selected (see Figure 23 and Figure 24). The chosen target value will appear in the right upper corner (see Figure 25). The values are always assigned to only one target value. To the following values the target values are assigned in the same way.

Before all other options and inputs are entered, the product name can still be changed here (see Figure 26).

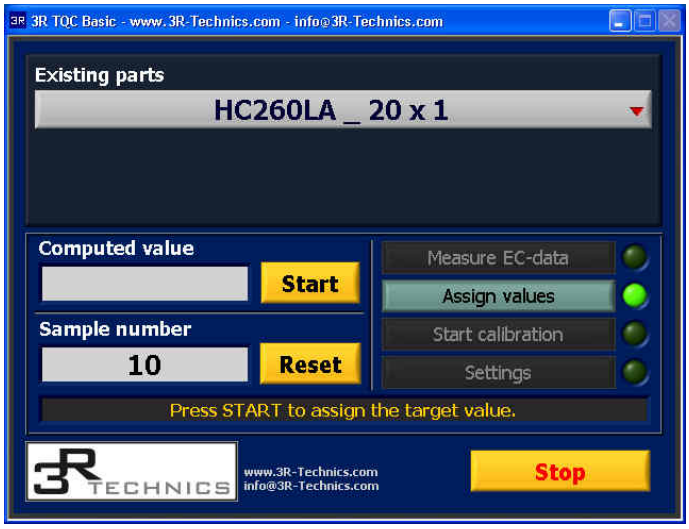



Figure 22: assigning of the values in the main menu


Figure 23: choosing of the target value


Figure 24: choosing of the target value - options


Figure 25: assignment of the values - input mask

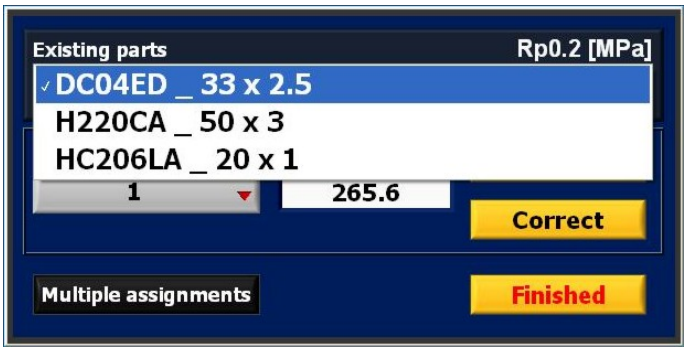



Figure 26: choosing of the part

First the sample number in the pull-down menu <<Sample>> should be selected (see Figure 27). It is not necessary to follow the order of the samples, but the measured values must be assigned to the correct sample number. The measured value is entered into the input field <<Value>>. The entering of the measured value belonging to the sample number should be confirmed by pressing the <<Assign>> button. The sample number for which the value is entered is then

deleted from the pull-down menu <<Sample>> (see Figure 28). This can be done for several samples one by one, as well as for several samples at once (see Figure 29).


Figure 27: selection of the sample number


Figure 28: selection of the sample number - the values were assigned to 6 samples

Pressing the button <<Multiple assignments>> in the menu <<Assign values>> a window opens, in which it is possible to assign target values acquired from conventional methods to several samples at once as well as to load these values from a txt-file by pressing the button <<Import file>> (see Figure 29). The form of the saved loaded values is shown in the Figure 30. The example file in the txt-format was imported from Microsoft Excel program. Columns are separated by the tabulator. After loading, the data is displayed in tables (see Figure 31). It is necessary to confirm the entered or loaded values by pressing the <<Assign>> button. The assignment of the values will be acknowledged immediately by a confirmation notice "*The values in the table were assigned*" and at the same time the button <<Assigned>> will be deactivated (see Figure 32).

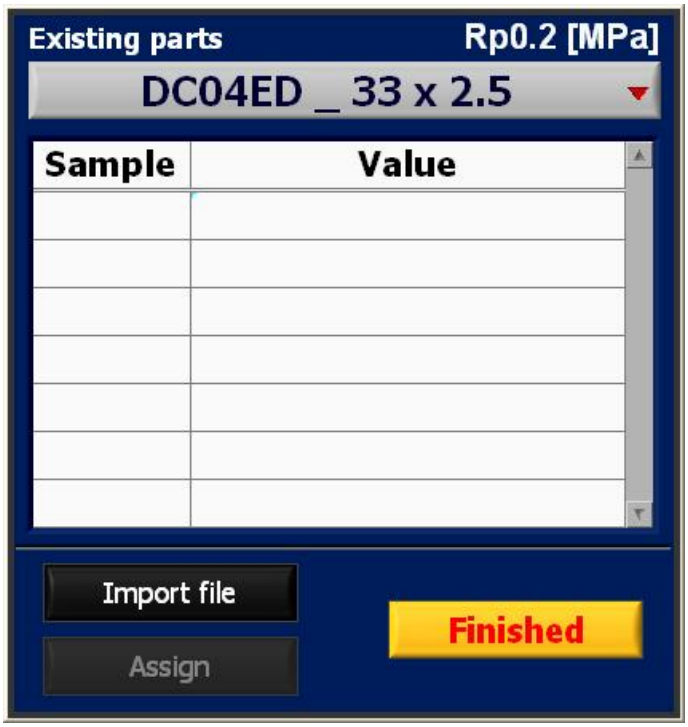



Figure 29: target values assignment to more samples at once – empty mask

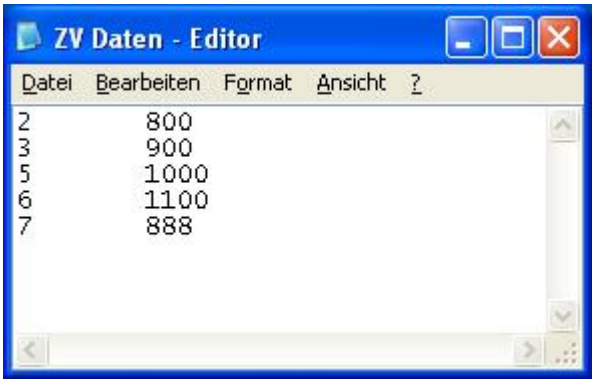



Figure 30: txt-file with conventionally acquired target values

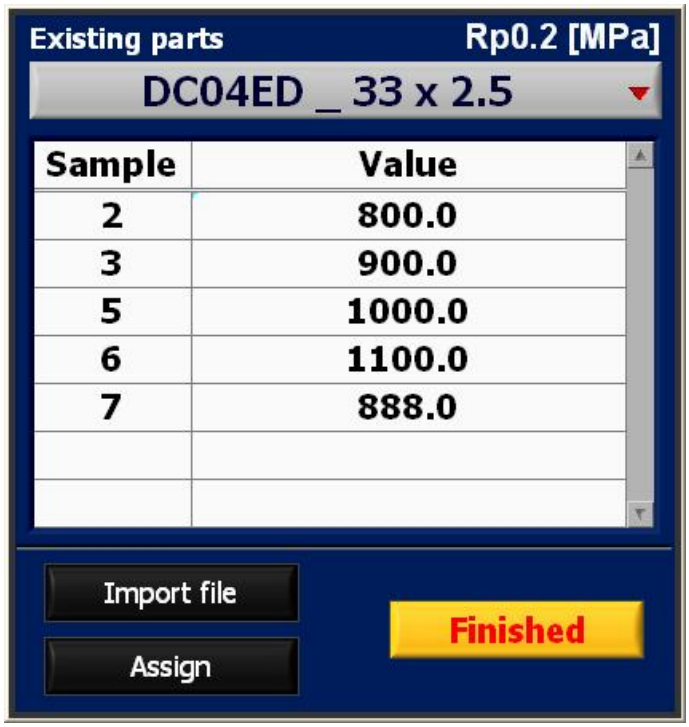



Figure 31: loaded target values

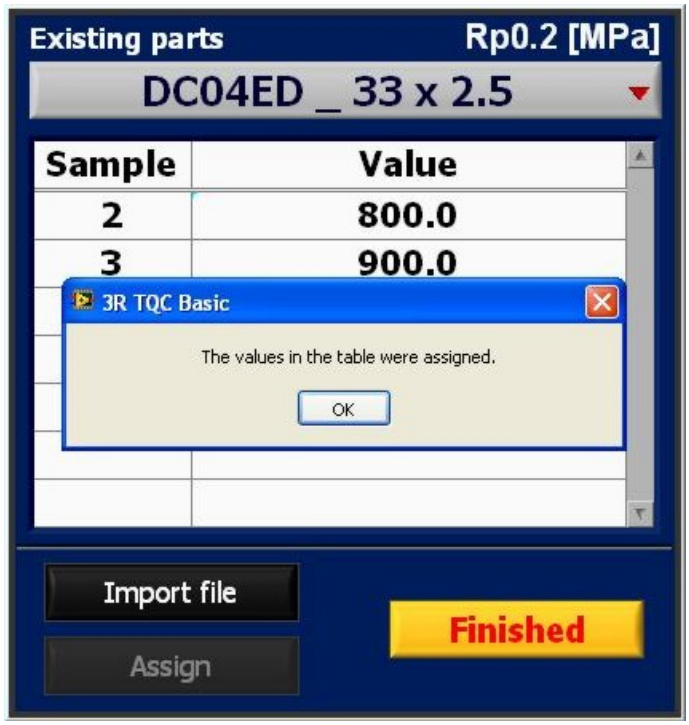



Figure 32: target values assignment

Material data should be assigned to all eddy current measurements, this is however not necessary. After 6 samples you can go to the next step (step 4 – calibration of the 3R TQC software) and the precalibration can be accomplished. That offers the possibility to carry out measurements although not all calibration samples were already entered. After the values were entered and assigned to the remaining samples, step 4 must be repeated again otherwise the data entered later will not affect the calibration and the exactness of the 3R TQC software.

The input of the measured values can be terminated with the button <<Finished>>.

## Correction

A mismatched value can be corrected also later. In the <<Assign value>> menu the button <<Correct >> should be pressed (see Figure 33 and Figure 34). In the pull-down menu <<Correct sample>> the sample numbers with the already assigned values of the target value are shown. They can be selected again. Then the value can be corrected (typed again) and the change must be confirmed with the <<Assign>> button. By pressing (deactivating) the <<Correct>> button again the input mask for the value assignment will be displayed again.

If all values are entered and assigned, the input operation can be closed by pressing the <<Finished>> button. To activate the changes step 4 (see below) must be executed too.


Figure 33: select the sample to be corrected


Figure 34: correct the assignment

## Step 4 – Calibration of the 3R TQC software

In order to compute the mathematical model of the interrelationship between the eddy-current values and the conventionally determined material characteristics, the button <<Start calibration>> should be pressed and the product name from the pull-down menu <<Existing parts>> selected (see Figure 35). After clicking on the <<Start>> button a window with defined target values overview will be opened (see Figure 36) or the computation (for 3R TQC Basic) will be started immediately.

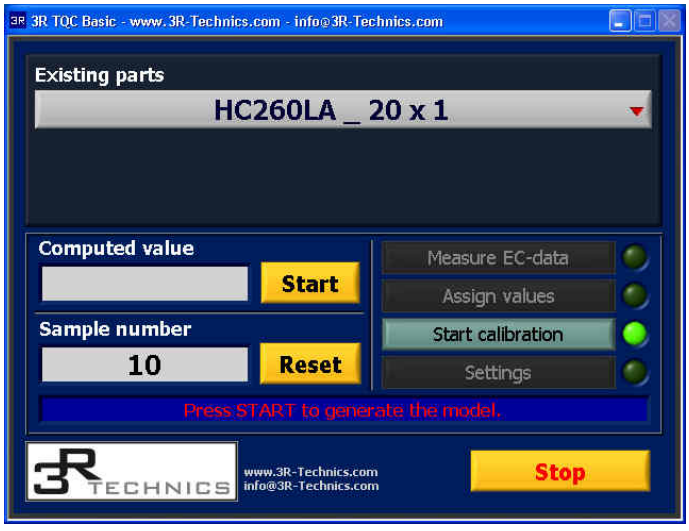



Figure 35: calibration before the start

The user can select which target values should be calibrated. Green diodes label target values with enough calibration data from which the user can select. Red diodes label target values with not enough calibration data or with incorrect EC-data (see <<Adapting the eddy-current data>> in the <<Setting>> menu). In the

Figure 36 the fifth value (R-Wert) cannot be selected and the remaining values can be and two of them are already selected (Rm and Rp0.2). Buttons in the left column are used for selection and the selection is confirmed by pressing the <<Finished>> button. The computation follows immediately. This procedure can take up to a few minutes; depending on the number of calibration samples (see Figure 37).

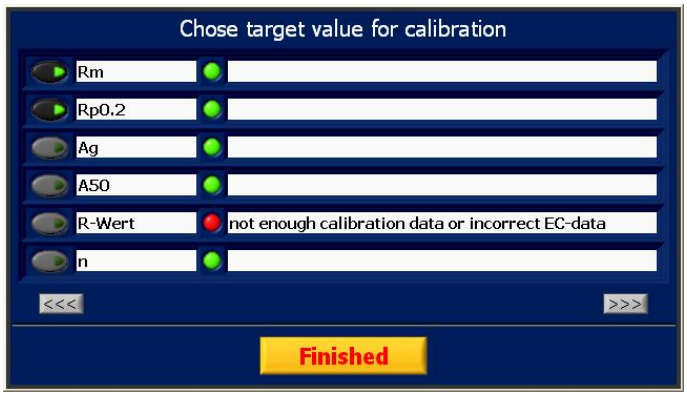



Figure 36: the overview of target values for calibration

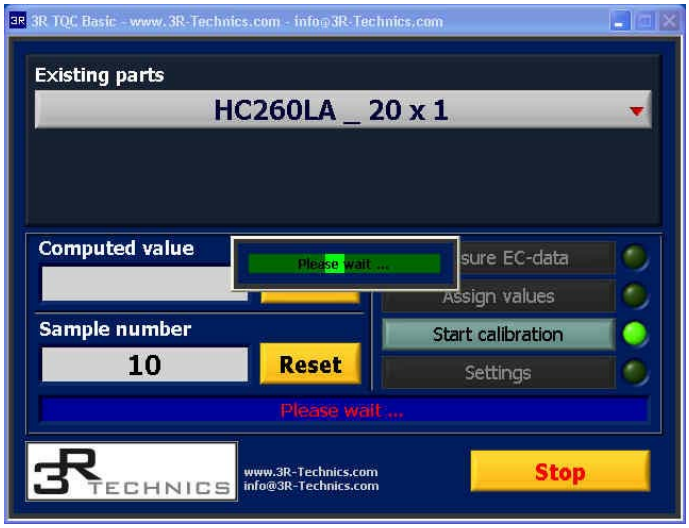



Figure 37: calibration after the start – during the computation process of the interrelationship

# Step 5 – Inspection - application of the 3R TQC software - computation of the mechanical material characteristic

After the calibration process the 3R TQC software can be used for the inspection of the calibrated material characteristics.


Figure 38: inspection for one target value

Before starting the inspection, the correct calibration of the inspection part and the part size must be selected from the pull-down menu <<Existing parts>>, e.g. “HC260LA_20x1” (see Figure 38). The measurement is triggered by pressing the <<Start>> button. Further trigger possibilities are described in the chapter Settings.


Figure 39: inspection for several target values

The computed value will appear in <<Computed value>> field (only in the Basic version). If several values are computed at once, they will be displayed in a table below <<Existing parts>> menu (see Figure 39). The number of displayed values depends on the 3R TQC software version.

If a name was selected for the measurement, for which no calibration has already been done, the message "*Model not existing!*" appears in the status line. The calibration has to be done first (see Figure 40).

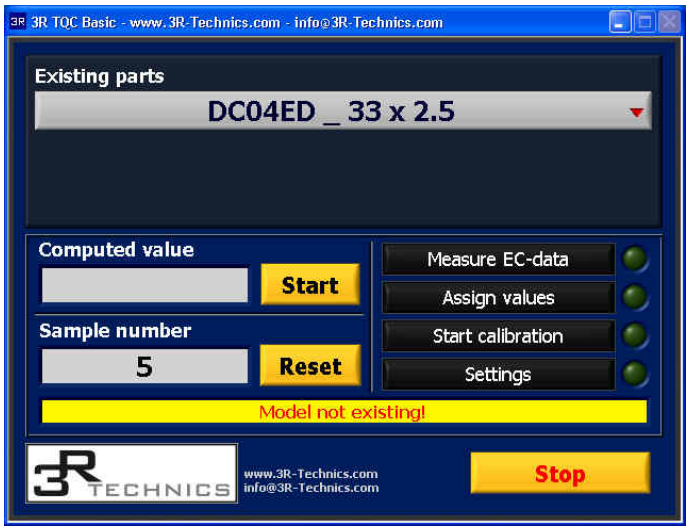



Figure 40: inspection impossible, model does not exist

# Settings

By pressing the <<Settings>> button and then the <<Start>> button (see Figure 41) a menu with several adjustment and correction options can be accessed (see Figure 42 and Figure 43).

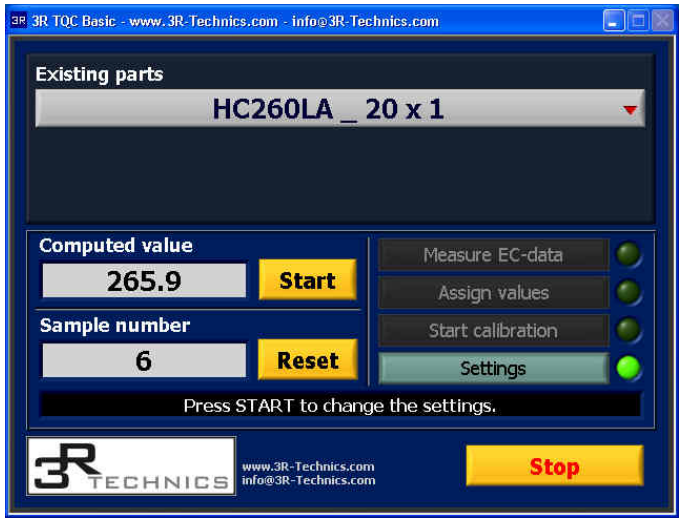



Figure 41: access to the settings menu

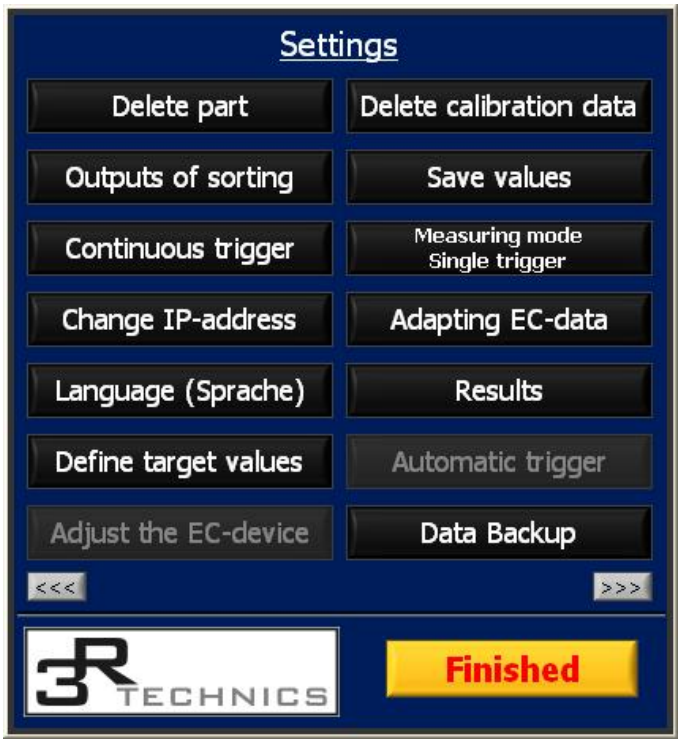



Figure 42: settings menu A

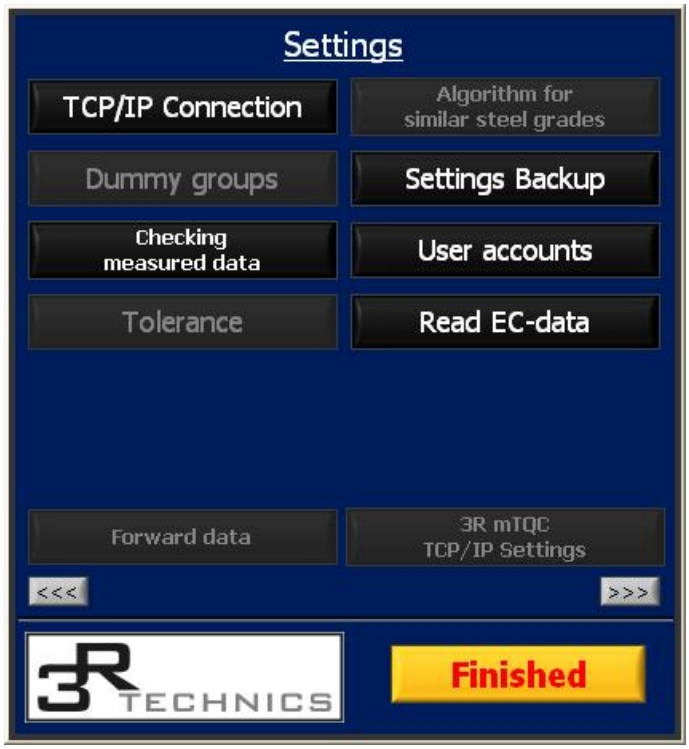



Figure 43: settings menu B

## Deleting a part/product

After pressing the <<Delete part>> button, a part can be selected in the pull-down menu and deleted completely with all data. The corresponding test definition is then released. After selecting the product (see Figure 44), the deletion starts by pressing the <<Delete>> button. Then the last possibility to stop this process appears (see Figure 45).


Figure 44: delete a product


Figure 45: delete a product - the last possibility to stop the deletion process

## Deleting calibration data

It is possible to delete data from the calibration files if an error is detected. The error may occur during the input of the conventionally determined material parameters when a wrong value was assigned during the value assignment process or when it is not sure whether the eddy-current values of one or more values were acquired correctly or not. This can be done through the menu <<Settings>>, then <<Delete calibration data>> (see Figure 42). After marking the sample number and the value, the deletion process is started by clicking on the <<Delete>> button (see Figure 46). The last possibility to stop this deletion process will be offered (see Figure 47). This deletion effects the measurement only if a calibration is started by pressing the <<Start calibration>> button (see Figure 35).

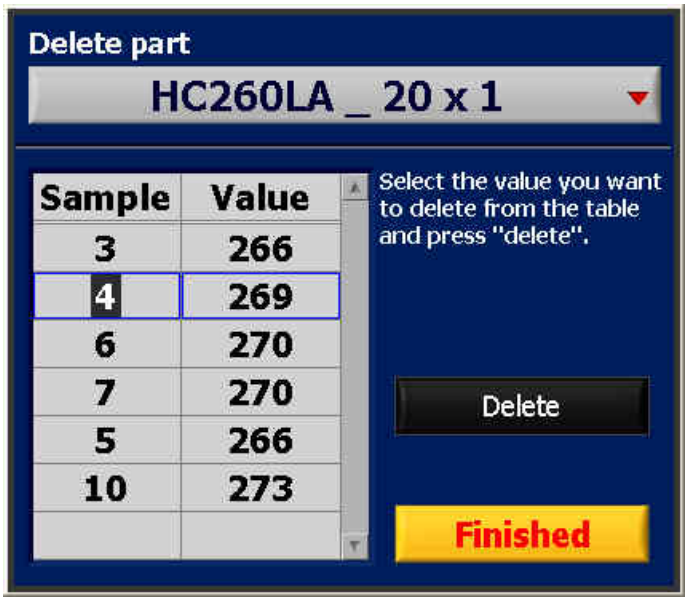



Figure 46: delete calibration data

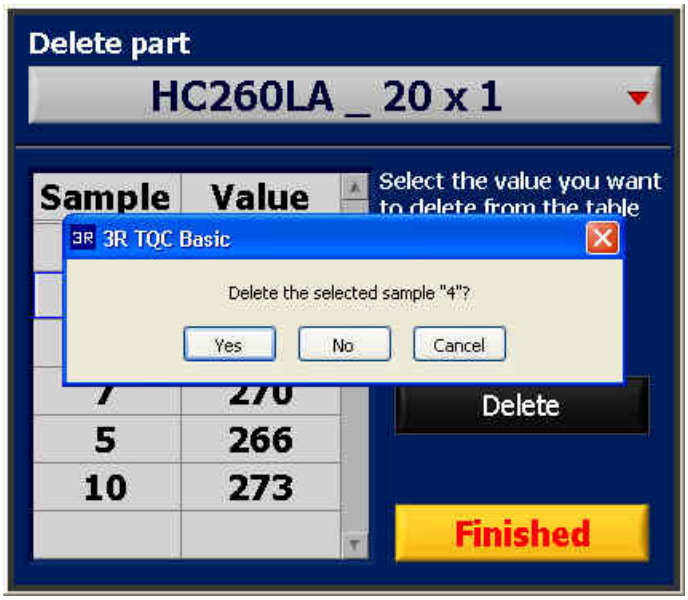



Figure 47: delete calibration data – the last possibility to stop the deletion process

# Outputs of sorting

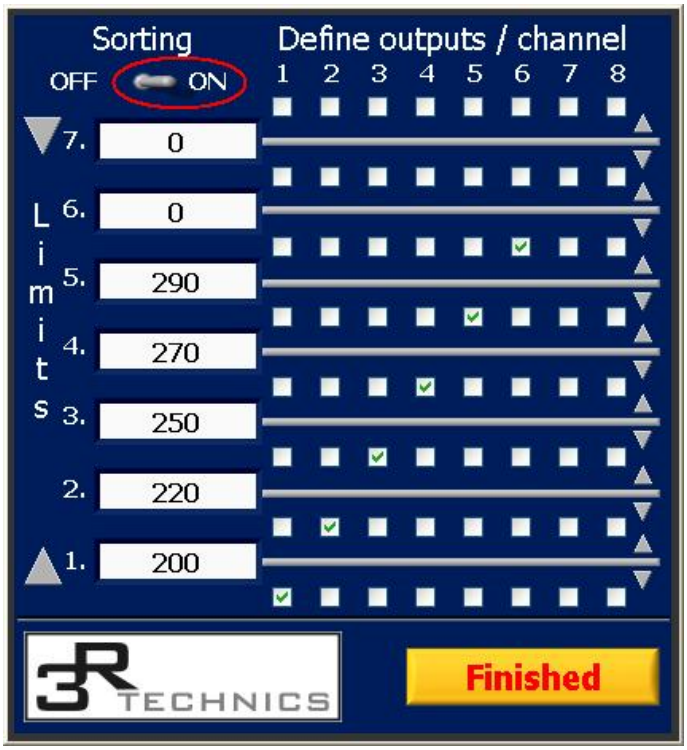



Figure 48: define the sorting outputs

By pressing the <<Outputs of sorting>> button, the sorting outputs are configured. If sorting signals are to be provided by the outputs of the Magnatest D device, this function has to be switched on first (see Figure 48 left above – red circle). From 1 to 7 limit values can be defined (see Figure 48 left). If this limit is not reached or is exceeded, one or more channels can be assigned.

An example configuration can be seen also in the Figure 48. 5 limits were set. If the measured value is below 200, the output 1 is switched on. If the measured value lies between 200 and 220, the output 2 is switched on etc. For the value over 290 the channel 6 is switched on. Further details of the outputs (Optoports) are described in the Magnatest D device manual.

## Save values

The measured data of the last 30'000 samples can be exported by pressing the <<Save values>> button in the <<Settings>> menu (see Figure 42). Before exporting the data, the product must be selected and confirmed with the <<Save>> button (see Figure 49). Then the path and the filename can be entered (see Figure 50). If the data for all requested products are exported, the menu can be closed by the <<Finished>> button. Exporting the data can take some time, depending on the number of samples.


Figure 49: save values

The sample-number is stored in the first column of the exported file. In the following N columns the eddy-current values are stored. N is 2 x the number of frequencies, since the real and imaginary part of the impedance are stored. In the last but one column the value of the target value that was computed on the basis of the eddy-current values is stored. If the eddy-current values lie outside the training (calibration) range "*Error measurement*" message will appear in the semifinal column. The last column is reserved for the Date/Time of the sample measurement.

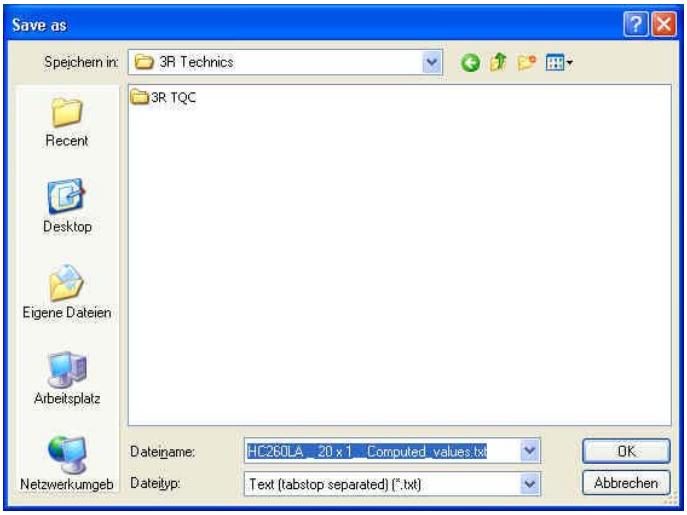



Figure 50: saving the values – entering the path

# Continuous trigger

As it was already mentioned, an individual measuring can be started by pressing the button <<Start>>. The 3R TQC software offers two other options: An externally started individual measurement (see Measuring mode / Single trigger) and also continuous measurement operated by external trigger. The configuration mask for a continuous measurement can be seen in the Figure 51. External triggering can be switched on the left side above. On the top right the trigger channel can be selected. Additionally a starting delay, measuring delay and stop delay in milliseconds can be set. The time of the starting delay defines the time between switching on the trigger signal (trigger flank) and beginning the measurement (see Figure 52 and Figure 53; in the example 200ms). The time of the stop delay defines the time between switching off the trigger signal and beginning the last measurement (in the example 300ms). The measuring delay determines the time between individual measurements (in the example 50ms). If the measuring delay is zero, the measurement is as fast as possible.

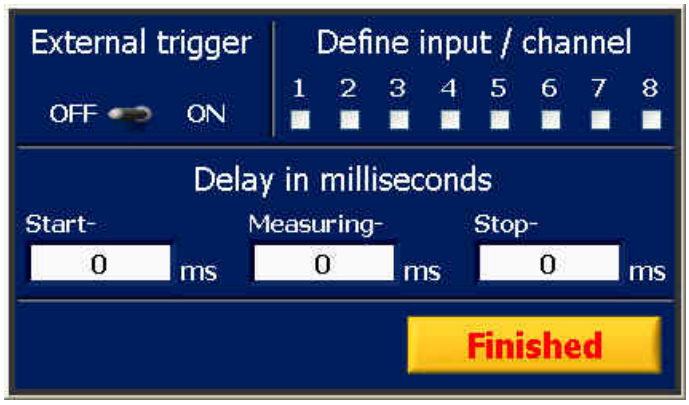



Figure 51: defining the continuous trigger

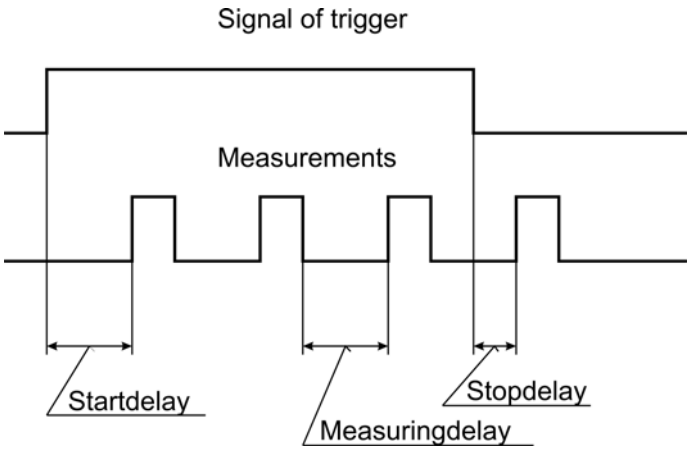



Figure 52: continuous trigger – explaining scheme

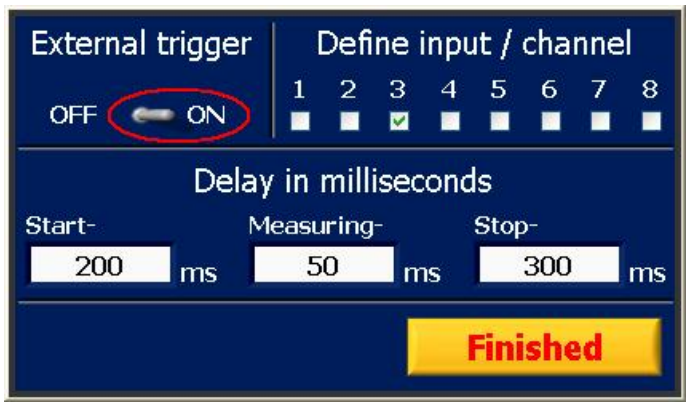



Figure 53: example of the definition of the continuous trigger

## Measuring mode / Single trigger

By pressing the <<Measuring mode / Single trigger>> button in the <<Settings>> menu, the operator can select whether the measurement will be started by pressing the <<Start>> button in the main menu (see Figure 38 or Figure 39) or internally or externally at the Magnatest D device. If it is switched to "*Manual*" (see Figure 54), the measurement is started by the button <<Start>>. If it's switched to "*Automatic*" the 3R TQC software waits for the data from the Magnatest D device and if new data are present, a new value for the target value is computed. The setting is confirmed by the button <<Finished>>.

Further details of triggering (manual with the button or external with the entrance signal) the Magnatest D device are described in the Magnatest D device manual.


Figure 54: measuring mode / external single trigger

## Change of the IP-address

The IP address can be changed in the <<Settings>> menu (see Figure 42) and then <<Change IP Address>> option (see Figure 55).


Figure 55: re-entering the IP-address of the MAGNATEST D device

After the confirmation of the IP-address by clicking the <<Finished>> button (see Figure 55), a connection with the MAGNATEST D device is established (see

Figure 57). If everything is all right, the message "*System ready*", as shown in Figure 58, will appear. If the message "*No connection to the eddy current device.*" displayed in Figure 59 is shown, please check again the IP address, the firewall if used (e.g. the access authorizations) and the cables as well as the connectors.


Figure 56: entering the Localhost IP-address


Figure 57: connecting after a new IP address was entered

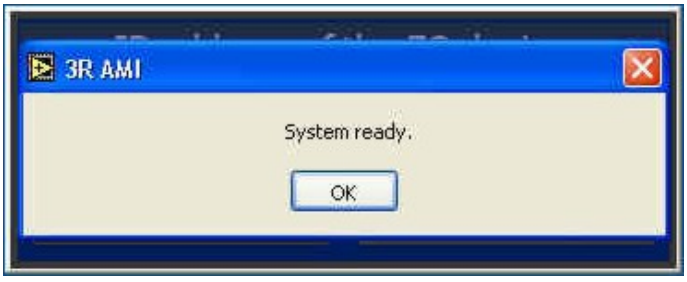



Figure 58: the connection is ok


Figure 59: error message after a new IP address was entered

## Adapting the eddy-current data

In this menu it is defined how many measurements per sample are done and from how many measurements an average value is calculated consequently. This average value is used for calibration. In the first phase for example, 20 measurements per sample can be done (*No. of measurements*). But the *Last value number* can be set to 10 and the number of measurements for the calculation of the average value *Average value from* to 5 (see Figure 60). This way, the average value is computed using the values numbers 6 to 10 and is used for calibration. If the settings of the three options in the *Default value* field are changed, the changed settings are used also for the following parts. If the *No. of measurements* and the number of measurements used to calculate the average value are larger, a better stability can be expected for the measurements. During normal production it is probably not possible to do so many measurements per sample due to time constraints, but it should be a goal to do as many measurements as possible.


Figure 60: eddy-current data adaption

# Language

With this function the language settings for the labelling of the control elements and the messages can be changed.


Figure 61: language settings

# Results of calibration

This function enables the control of calibration results. It can be started by pressing the <<Results of calibration>> button in the <<Settings>> menu (see Figure 42). After this function is started, the target value for which the calibration results should be shown must be selected in the <<Chose target value>> pull-down menu (see Figure 62). The number of values in the pull-down menu (see Figure 63) depends on the 3R TQC software version. The default number of values varies from one to six, but it may be higher on special request.

The shown results can be seen in Figure 64. In this window the product <<Existing part>> can be changed and thus the calibration results for the selected target value of various products viewed.

The table columns contain follows:

1st column – Sample Nr. – sample number

2nd column – Target value T – target value measured by a conventional method, e.g. tensile test

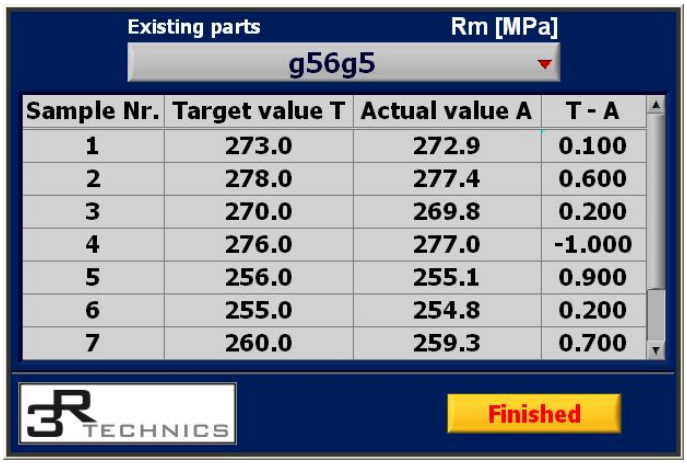
3rd column – Actual value A – target value computed on the basis of values measured by eddy-current method

4th column – T - A – difference between conventionally measured values and values computed on the basis of values measured by eddy-current method

To finish the calibration results view, press the <<Finished>> button.


Figure 62: target value choice


Figure 63: target value choice - options




| Sample Nr. | Target value T | Actual value A | T - A |
|---|---|---|---|
| 1 | 273.0 | 272.9 | 0.100 |
| 2 | 278.0 | 277.4 | 0.600 |
| 3 | 270.0 | 269.8 | 0.200 |
| 4 | 276.0 | 277.0 | -1.000 |
| 5 | 256.0 | 255.1 | 0.900 |
| 6 | 255.0 | 254.8 | 0.200 |
| 7 | 260.0 | 259.3 | 0.700 |

Figure 64: calibration results for a chosen target value

## Define target values

This function enables the users to enter their own name for the target value instead of its default name TV 1, TV 2, etc. (see Figure 65). The number of target

values depends on the 3R TQC software version. At the same time it is possible to enter units of measurement, e.g. MPa, %, etc. and the exactness with which the individual target values should be shown. The number of decimal places after the comma / point should be entered. The example of a user definition is shown in the Figure 66.

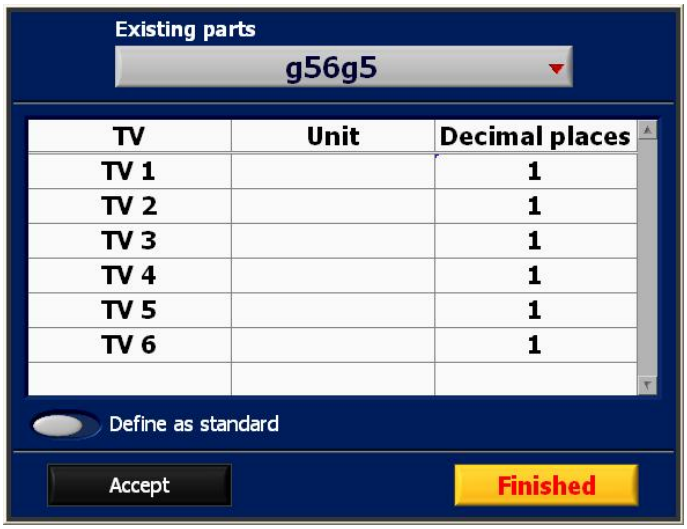



Figure 65: define-target-values window – default setting

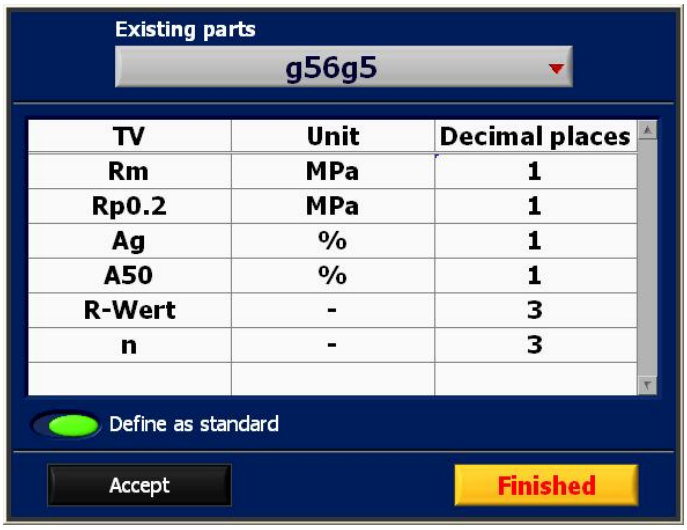



Figure 66: define-target-values window – user's setting

This setting can be used individually for a certain product or by default for all the products at once with the exception of individually marked ones. By default setting the <<Define as standard>> switch must be activated and highlighted

green (see Figure 66). To activate the settings, press <<Accept>>, to finish it, press <<Finished>>.

## Automatic trigger

This function is designed for 3R AMI software.

## Adjust the EC-device

In the development stage: This function will become active in the next version.

## Data Backup

In this menu, automatic backup of test results can be set (see Figure 67). The setting can be performed individually for each product/dimension or as a standard equally for all the products at once. If setting is done for some products individually and subsequently the setting is done as a standard <<Define as standard>>, then the settings of individually set products/dimensions remain unchanged. Backup can be activated and deactivated <<Data Backup>> and a directory where the data should be stored can also be chosen or created. The settings need to be confirmed through the <<Accept>>button. While saving the data, subdirectories will be created automatically according to products/parts.


Figure 67: Menu – Backup

Inspection results will be recorded twice; once every 131 data, and once every 3001 data, or when changing a product/part as well as when switching off the software. The number of the recorded data is expressed in prime numbers in order to prevent and avoid the situation that both records will be performed at the

same time. The following will be stored: 350 files each containing 131 data or lines and 700 files each containing 3001 lines. When this number is completed, the oldest file will be deleted.

Recorded data contain:

*Sample number*

*Part*

*Frequency_1-X, Frequency_1-Y* (the values – results of a measurement obtained through the eddy current method i.e. real and imaginary component of every measured frequency), …

*Test definition* (see hardware instructions/manual),

*Number of parameter sets*

*Number of measurements*

*Last value number* – Sequence number of the last measured value used for creating a model

*Average value from* – Number of values used for the calculation of an average value

*1st Name of the target group [unit of measurement] e.g. Rm [MPa]*

*2nd Name of the target group [unit of measurement] e.g. Rp0.2 [MPa]*

*Nth Name of the target group [unit of measurement] e.g. A50 [%]*

*Date/time*

*Sample number*

# TCP/IP Connection

Menu <<TCP/IP Connection>> enables to activate communication via Ethernet by means of TCP/IP protocol (see Figure 68). The Network port <<Network port>> is set here, too. Settings can be performed individually, thus each product/part <<Existing parts>> can be controlled either separately, e.g. from a different server, or it will be impossible to choose some products by means of remote access. One setting for all products can be performed at once by activating the <<Define as standard>> switch. The settings need to be confirmed by pressing the <<Accept>> button.

TCP/IP connection is used for the communication between the 3R TQC and 3R mTQC software. **3R mTQC software cannot be used without the activated connection as well as without the 3R TQC software.** TCP/IP connection is also used for communication between 3R TQC software and optional user's software that uses following commands which are sent via TCP/IP protocol.


Figure 68: TCP/IP Connection

This communication enables to control the software remotely through the following commands.

Command 1:

*ExistingParts*

Response 1:

*ExistingParts:#88x11.9; #244x11.5; #101x11;*

Command 2:

*ActivateCalibratedPart=88.9x9.35*

Response 2:

*CalibratedPart=88.9x9.35*

Command 3:

*CalibratedParts*

Response 3:

*CalibratedParts:#88x11.9; #101x11;*

Command 4:

*Result*

Response 4:

*Result 1 88x11.5 5478 2014 100 91……*

Command 5:

*StopExternalTrigger*

Response 5:
*StopExternalTrigger*

Command 6:
*StartExternalTrigger*
Response 6:
*StartExternalTrigger*

Command 7:
*Off*
Response 7:
*SystemClosed*

Command 8:
*ReBoot*
Response 8:
*SystemRestarted*

Command 9:
*Exit*
Response 9:
*3RAMI/3RTQC-Closed*

Command 10:
*ActivePart*
Response 10:
*ActivePart=88x11.9*

At the end of each data chain, there is hexadecimal 00.

## Algorithm for similar steel grades

This function is designed for 3R AMI software.

## Dummy groups

This function is designed for 3R AMI software.

## Settings Backup

This function enables to activate the backup of the settings (databases) on the Magnatast D device, 3R TQC software settings and calibration. This function can be activated by <<Settings Backup>> in the <Settings>> menu (see Figure 43). The backup is activated in the <<Setting Backup>> menu by <<Backup>> (see Figure 69 left upwards).

If the settings databases for the Magnatest D device and the 3R TQC software are on the same computer and on the same hard-disc, it means that the 3R TQC software is installed directly on the Magnatest D device, automatic search can be started by <<A_Search>> in <<Path to databases>>.The path to databases will be searched automatically. The search can take some time during which the notice *Please wait* will appear (see Figure 70). If the databases (Magnatest D settings) were found but they are incorrect, e.g. if the users have already done their own backup, it is possible to continue by pressing the <<Next>> button (see Figure 71). If the databases were not found (see Figure 72), what means they are saved on another hard-disc, please, select the right disc or its partition manually by <<Search>>.

The path for saving settings backups <<Path for backup>> must be selected manually through <<Search>>.Two folders will be created on the backup; one for the Magnatest D device settings backup and the other one for 3R TQC software calibration settings backup.

If the backup is activated it is performed in the predefined time during the calibration. Additional backup can be activated by <<Additional backups at>> <<Start of software>> at the start of the 3R TQC software, and by <<Finish of software>> on switching off of the software.

The settings must be confirmed by <<Accept>>. To finish the settings press <<Finished>>.

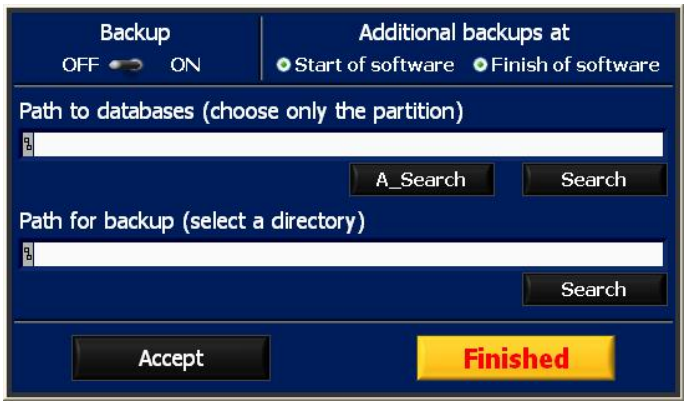



Figure 69: Settings Backup – not set / inactive

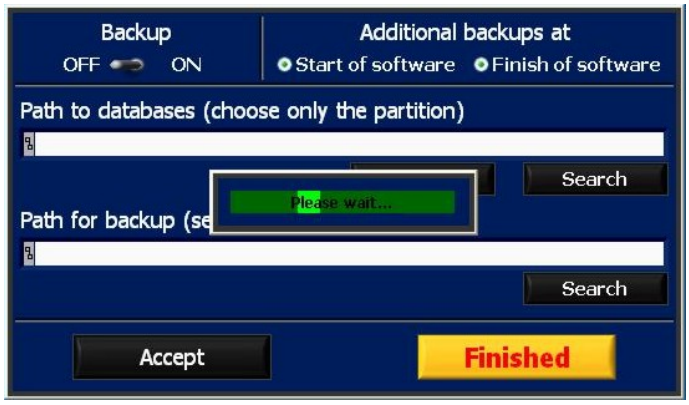



Figure 70: Settings Backup – searching the databases

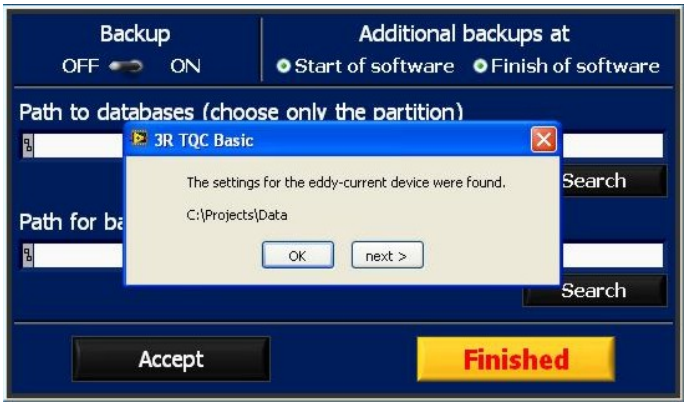



Figure 71: Settings Backup – databases were found

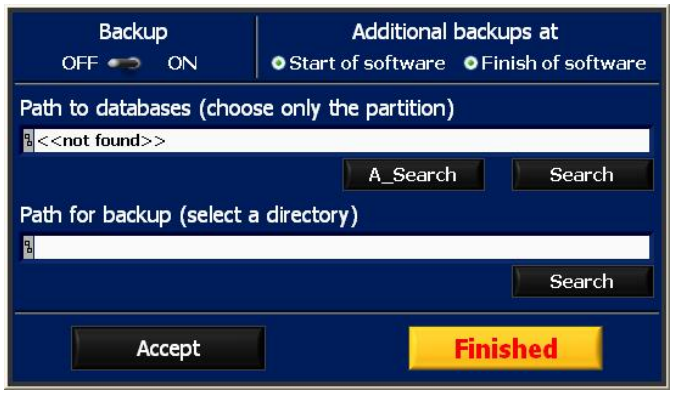



Figure 72: databases of the Magnatest D device settings were not found

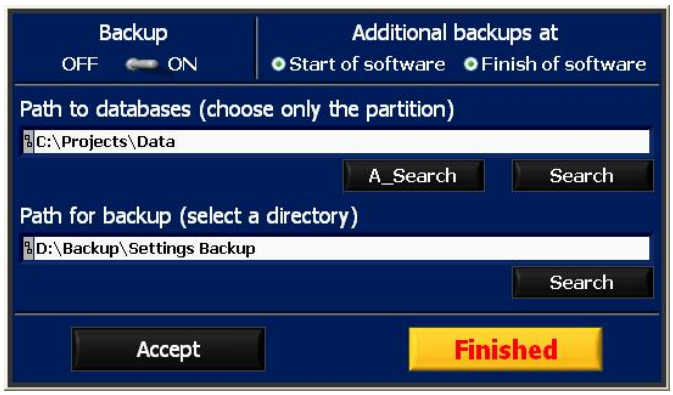



Figure 73: Settings Backup – example settings

# Checking measured data

If this function is active, data measured by Magnatest D will be checked automatically and in case the measurement is not accomplished, the error-message will appear. If the error-message appears, software and hardware of Magnatest D should be checked or technical support contacted. It will be most likely an error on Magnatest D software installation.


Figure 74: measured data check

## User accounts

This function is designed for 3R AMI software.

## Tolerance

This function is designed for 3R AMI software.

## Access to eddy-current data

This function enables to re-read the already measured data of testing samples again and to assign testing samples once again. Thus the calibration can be inspected without the necessity to carry out new measurements of the samples. This function can be activated by <<Read EC-data>> in the <Settings>> menu (see Figure 43). If this function is activated (see Figure 75) a new button will appear in the main menu (see Figure 76). After pressing the <<Start>> button a new window will be opened offering the option to choose a data file. In the "3R Technics" directory there is a subdirectory created for each product (part) in which a "*Berechnete_Werte.txt*" file can be found. The file contains all samples tested for the given product (part). After choosing the right "*Berechnete_Werte.txt*" data file, groups will again be assigned to measured data and the new assignment will be stored in "*Berechnete_Werte_S.txt*" file. Various optional data can be read and re-counted, but their format and structure must be preserved, i.e. they must correspond with those in "*Berechnete_Werte.txt*" file.


Figure 75: Permission to access the reading of eddy-current data

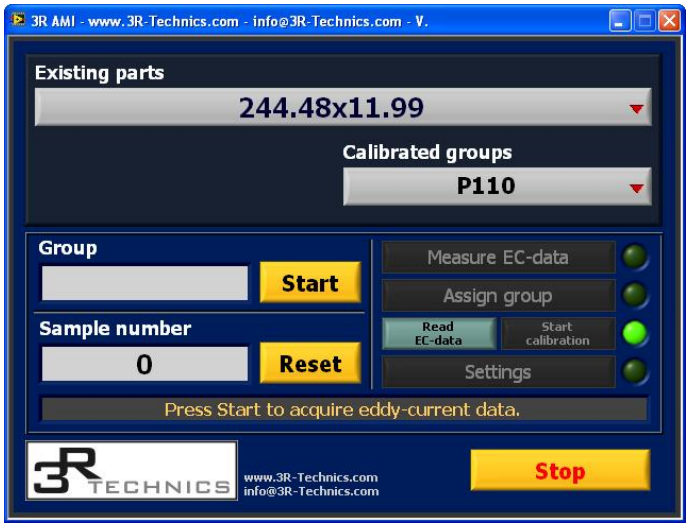



Figure 76: Main menu – access to the reading of eddy-current data

# Forward data – 3R mTQC

The TCP/IP configuration to forward data for postprocessing can be done in the <<Settings>> menu (see Figure 43) and then <<Forward data>> option (see Figure 77).

It the user wants to postprocess the data, the data forward must be activated by the <<TCP/IP Connektion>> switch. At the same time the IP-address of the target computer as well as the network port must be set correctly. The settings must be confirmed by pressing the <<Accept>> button. To finish the configuration the button <<Finish>> should be pressed.

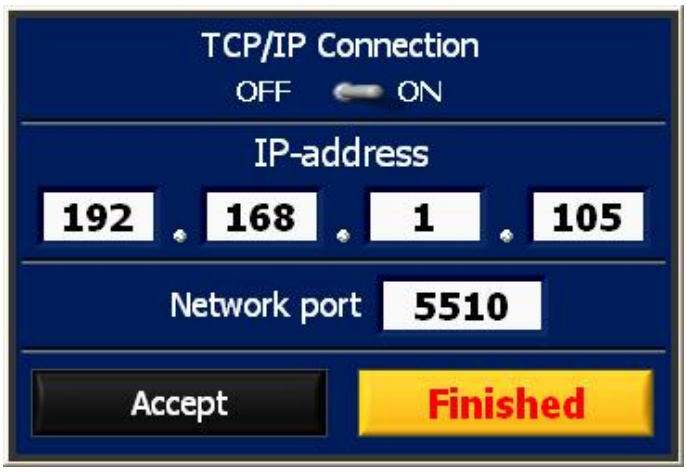



Figure 77: configuration of the TCP/IP connection for measured data forward

The forwarded data format is identical with the format used in Data Backup for each measuring place or device. At the beginning of each measured data group there is a column with measuring device name, and the data belonging to each measuring device are separated by tabulator.

## Change of the TCP/IP configuration – 3R mTQC

The TCP/IP configuration can be changed in the <<Settings>> menu (see Figure 43) and then in the <<3R mTQC TCP/IP Settings>> option (see Figure 78).

The name of the measuring device is entered into the table with the white background. If you e.g. have 3 measuring devices you want to measure with simultaneously by 3R mTQC, it is possible to assign each of them a name, e.g. Device 1, Device 2, etc. At the same time the IP-address and the port number must be entered. It is also necessary to define the disc or disc partition where the 3R Technics directory is stored. The 3R Technics directory is always located on the same disc or disc partition along with Windows® operating system. This disc or disc partition must be accessible for 3R mTQC software since 3R TQC software and 3R mTQC software share the data and directories of the 3R TQC software that are in the measuring device. Name, IP-Address, Port and disc must be entered and confirmed by pressing the <<Add>> button for each measuring device individually. After the confirmation the setting will appear in the table with the grey background. The measuring device settings can be deleted by selecting the device's name in the pull-down menu and pressing the <<Delete>> button (see Figure 79). All changes must be confirmed by pressing the <<Accept>> button. Work in this window is done by pressing the <<Finished>> button.

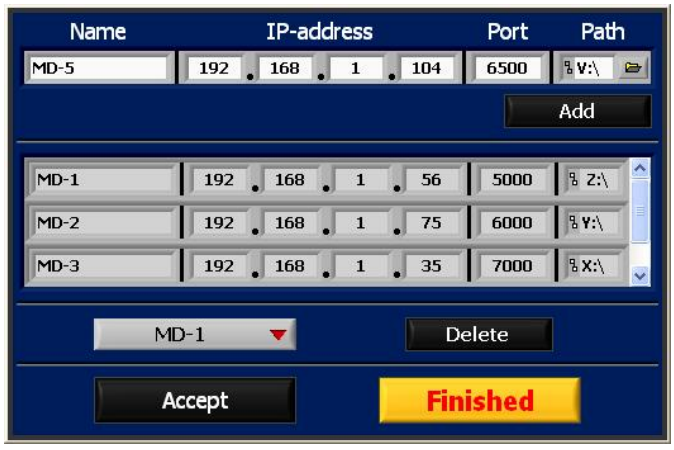



Figure 78: configuration of the TCP/IP-connection – add measuring device

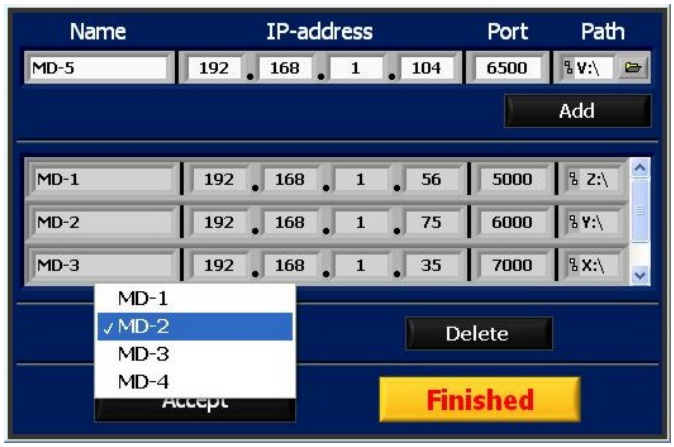



Figure 79: configuration of the TCP/IP-connection – delete measuring device